BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 2 SEPTEMBER 1953 PART 1

INSTITUTE NEWS

Election of Council for 1954–55

In accordance with the Articles of Association, the following are due to retire from the Council at the 1954 Annual General Meeting:

President:

Professor F. C. THOMPSON, D.Met., M.Sc., F.I.M.

Past-President:

H. S. TASKER, B.A.

Vice-Presidents:

A. B. GRAHAM

P. V. HUNTER, C.B.E., Hon. M.I.E.E.

Ordinary Member of Council:

L. B. PFEIL, O.B.E., D.Sc., A.R.S.M., F.R.S., F.I.M.

Under Article 19, Professor F. C. THOMPSON will fill the vacancy on the Council as Past-President.

In accordance with Article 22, the Council nominates the following members to fill the other vacancies:

As President:

S. F. DOREY, C.B.E., D.Sc., F.R.S., M.I.C.E., M.I.Mech.E., Chief Engineer Surveyor, Lloyd's Register of Shipping, London.

As Vice-Presidents:

MAURICE COOK, D.Sc., Ph.D., F.I.M., Joint Managing Director, Imperial Chemical Industries, Ltd., Metals Division, Birmingham.

L. B. PFEIL, O.B.E., D.Sc., A.R.S.M., F.R.S., F.I.M., Director, The Mond Nickel Co., Ltd.; Director, Henry Wiggin and Co., Ltd., London.

Major P. LITHERLAND TEED, A.R.S.M., F.R.Ae.S., M.I.M.M., F.I.M., Assistant Chief of Aeronautical Research and Development, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey.

As Ordinary Members of Council:

R. D. HAMER, B.Sc., Dipl.Ing., Vice-President and Director, Aluminium Laboratories, Ltd., Banbury; Director, Magnesium Co. of Canada, Ltd., Montreal.

G. P. TINKER, M.Sc., F.I.M., Managing Director, Birlec, Ltd.; Director, Birmingham Electric Furnaces, Ltd.

Members are reminded that, in accordance with Article 22, any ten members may also at, or before, the business part of the Autumn General Meeting (21–24 September 1953), nominate in writing, with the written consent to act if elected of the person nominated, any duly qualified person other than one of those nominated by the Council to fill any vacancy on the Council, but each such nominator is debarred from nominating any other person for the same election. If two or more persons are nominated for any honorary office they (or such of them as are not Ordinary Members of Council who are not retiring at the next Annual General Meeting) will be deemed to have been nominated also for any vacancies among the Ordinary Members of Council. No person is eligible to fill any vacancy at such Annual General Meeting unless he has consented in writing to be nominated and has been nominated or deemed to be nominated for the same in compliance with this Article.

Senior Vice-President, 1954–55

The Council has elected Dr. MAURICE COOK, F.I.M., to serve as Senior Vice-President for 1954–55, and he will be their nominee for the Presidency in 1955–56.

Students' Essay Prizes

Regulations

The Council will present two prizes of twenty guineas each for the best essays submitted in accordance with the regulations set out below. Each prize will be in the form of ten guineas in money and ten guineas in scientific, technical, or other appropriate types of books, to be selected by the prizewinner. If of sufficient merit, a prize-winning essay may be published in the Institute's *Bulletin* or selected for reading before a Local Section.

(1) *Eligibility.*—The competition is open to all Student Members of the Institute, and to all Associate Members of Local Sections who are eligible for Student Membership of the Institute, provided that both are within the normal age limits for Student Membership, viz. 17 to 25 years. The competition is not restricted to persons who are undergoing courses at a University or Technical College; it is open to all persons within the age limit stated. A prizewinner will be ineligible to compete in the competition in the year subsequent to that in which he or she submitted a winning essay.

(2) *Language.*—Essays must be submitted in English.

(3) *Length.*—Essays should be 2500–3500 words long and must not exceed 3500 words. They must be submitted in typewritten form with double-line spacing.

(4) *Subject.*—The choice of subject is left to the competitors, except that subjects relating exclusively to extraction or

ferrous metallurgy are ineligible. It is intended, though this may be varied as may be found necessary, that one prize shall be awarded for a paper on a theoretical subject and the other for a paper on a practical subject. The subject matter should be logically presented, in good English, and *should have a metallurgical content to impress the adjudicators by soundness, exercise of critical faculty, and originality of approach.* No prize will be awarded if the essays do not, in the opinion of the adjudicators, reach the requisite standard.

(5) *Method of Submission.*—Each entry must be submitted to The Secretary, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1, not later than 1 January 1954, and must be accompanied by a certificate, signed by the entrant, that the essay itself is entirely his or her own work, that it has not, in the form in which it has been sent, been submitted for any other competition, and clearly stating what (if any) drawings, photographs, &c., have been prepared on his or her behalf.

(6) *Presentation of Prizes.*—The prizewinners will receive their prizes from the President, when he presents the Medals awarded by the Institute, at the Annual General Meeting.

PERSONAL NOTES

MR. H. E. ARBLASTER is on a visit to England on behalf of his firm, Commonwealth Aircraft Corporation Pty., Ltd., Melbourne.

M. J. BAUCHET has been appointed Directeur Technique, S.A. Commentry-Fourchambault et Decazeville, Paris.

MR. K. G. BLACKMORE has left Aluminium Laboratories, Ltd., to take up a post as Assistant Metallurgist with The de Havilland Aircraft Co., Ltd., Airspeed Division, Christchurch, Hants.

MR. D. F. BRIDGES is now Assistant Chief Metallurgist to Southern Forge, Ltd., Langley, Bucks.

MR. D. A. BROWN has been awarded the B.A. degree of Cambridge University.

MR. G. L. BUCKNELL has left the A.E.I. Research Laboratories, Aldermaston, and taken a post in the Research Laboratories of The General Electric Co., Ltd., Wembley.

MR. A. CHAMBERLAIN has been awarded the degree of M.Eng. of Liverpool University.

MR. N. J. CHAPLIN is now employed as a Development Engineer by Canadian Radio Manufacturing Corp., Ltd., Leaside, Toronto, Ont.

PROFESSOR P. CHEVENARD has been awarded the Médaille Gustave Trasenster for 1953 by the Association des Ingénieurs Sortis de l'Ecole de Liége.

MR. G. CLOUGH has been awarded the M.Sc. degree of Leeds University.

DR. G. B. CRAIG has left the University of Toronto and taken up an appointment in the Physical Metallurgy Division, Department of Mines and Technical Surveys, Ottawa.

MR. H. B. CRAWFORD has been appointed Deputy to the Chief Metallurgist, F. Perkins, Ltd., Peterborough.

MR. H. CRYSTAL has been awarded the degree of B.Sc. Tech.

MR. L. H. DAVENPORT has taken up an appointment as Physical Metallurgist in the Research and Development Division of the Consolidated Mining and Smelting Co. of Canada, Trail, B.C.

MR. EDWIN DAVIS has been appointed Technical Manager, Metal Production "A" (Tubes) at Imperial Chemical Industries, Ltd., Metals Division, and took up his duties on 1 July last.

PROFESSOR POL DUWEZ, Professor of Mechanical Engineering at the California Institute of Technology, has recently been on a five-week mission to Europe on behalf of the U.S. Air Force. He is assisting in the establishment of a programme under which the Office of Air Research and Development Command will sponsor basic research by Western European scientists.

MR. HENRY J. FISHER, Metallurgist with the Physical Metallurgy Division of the Canadian Department of Mines and Technical Surveys, has recently been awarded the degree of Doctor of Engineering by Yale University.

DR. R. GENDERS has been appointed metallurgical consultant to the Vanadium Corporation of America.

MR. W. R. GEORGE has left University College, Swansea, to take up an appointment in the Nelson Research Laboratories of the English Electric Co., Ltd., Stafford.

MR. A. K. HEAD has returned to Australia after working for a time at the H. H. Wills Laboratory at Bristol University.

MR. W. R. HEBBLEWHITE has retired from the Directorship of the Standards Association of Australia. He joined the Association as its first full-time officer in 1924.

MR. O. W. HUMPHREYS has been appointed to the board of directors of The General Electric Co., Ltd., London.

DR. H. LAMBOT, of the Institut de Cristallographie et de Minéralogie, Université de Liége, has been appointed Research Associate at the College of Engineering of the University of Illinois, Urbana, Ill., from 1 July 1953 to 31 August 1954.

MR. A. H. LINES has left Cambridge University and is now with D. Napier and Sons, Ltd., Acton, W.3.

MR. N. A. MCKINNON has returned to the Aeronautical Research Laboratories, Melbourne, after having spent a year at the Atomic Energy Research Establishment, Harwell, and a year in the Metallurgy Department at Birmingham University.

MR. R. G. P. MAYO has been appointed Works Manager of Impregnated Diamond Products, Ltd., Tuffley, Gloucester.

MR. A. L. MINCHER is now with Canadian Copper Refiners, Montreal.

FLT.-LT. F. MOBEY is now studying at the College of Aeronautics, Cranfield, Bletchley, Bucks.

DR. S. MOCARSKI has left the Canadian General Electric Co. and joined Sheepbridge Engineering (Canada), Ltd., Guelph, Ont., as Technical Engineer in charge of metallurgical control and inspection.

MR. M. S. PATERSON has left the Aeronautical Research Laboratories, Melbourne, to become a Senior Research Fellow in the Department of Geophysics at the Australian National University, Canberra.

Dr. A. J. Phillips, Director of Research to the American Smelting and Refining Co., Barber, N.J., has been elected a Vice-President of the Company.

Mr. P. Potter has left H. J. Enthoven and Sons, Ltd., to take up an appointment with the Ford Motor Co., Ltd., Dagenham, as a metallurgist.

Mr. J. Preston, having completed the visit to the United States which he undertook with the aid of a Mond Nickel Fellowship, has taken up an appointment in the Research Department of the Metals Division of Imperial Chemical Industries, Ltd., Birmingham.

Mr. B. R. Price has been appointed Research and Development Engineer, National Tube Division, U.S. Steel Co., McKeesport, Pa., U.S.A.

Mr. T. Pritchard has been appointed Chemist in Charge at the new Kirkby Works of Imperial Chemical Industries, Ltd., Metals Division.

Professor Luigi Rolla has retired from the position of Head of the Department of General Chemistry at the University of Genoa, which he had held since 1935. In recent years he has worked extensively on the rare-earth metals and alloys.

Mr. J. D. Sharp has been awarded the B.A. degree of Cambridge University.

Mr. M. D. Smith has been awarded the M.Met. degree of Sheffield University.

Mr. T. B. Smith has been awarded the degree of B.Sc. with Honours in the School of Physical and Theoretical Metallurgy at Birmingham University.

Mr. Jerome Strauss, Vice-President of the Vanadium Corporation of America, has received an Award of Merit of the American Society for Testing Materials, in recognition of his outstanding services to the Society, particularly in connection with its technical committee work. He has been Chairman of A.S.T.M. Committee A-10 on Iron–Chromium, Iron–Chromium–Nickel and Related Alloys since its inception in 1929. Mr. Strauss gave the H.W. Gillett lecture at a recent meeting of the Society, on the subject of " Micrometallurgy ".

Mr. J. W. Suiter has been appointed a Research Officer, C.S.I.R.O., Physical Metallurgy Division, Baillieu Laboratory, University of Melbourne.

Deaths

The Editor regrets to announce the death of:

Mr. Charles Ernest Frederick Plutte, Managing Director of Enfield Rolling Mills, Ltd., on 8 July.

Mr. William Joseph Terry, Chairman and Managing Director, London Electric Wire Co. and Smiths, Ltd., on 27 July.

OBITUARY

Professor D. Hanson

Dr. Daniel Hanson, Feeney Professor of Metallurgy in the University of Birmingham, whose untimely death occurred suddenly on 12 June, was one of the most notable research scientists that the Institute of Metals has numbered among its members. During many years he was conspicuous in the Institute and added lustre to it; he markedly enriched its proceedings by his publications and his personality. In 1930 he was the Autumn Lecturer; for nearly twenty years he was a Vice-President or Member of Council, and doubtless, had he been so minded, might have been President. It is probable that the period of his most intimate participation in the affairs of the Institute was the happiest phase of his professional life. That life falls into three, fairly sharply differentiated, periods.

Born in Cheshire in 1892, Hanson was a pupil at Wallasey Grammar School, proceeding thence to Liverpool University. While yet a schoolboy he had formed a clear notion of the career he wished to pursue—to be a research scientist—and he never deviated from that choice of vocation. After graduation he remained at Liverpool long enough to make an investigation into the tensile properties of copper at high temperatures, with Dr. G. D. Bengough, the results being published by them jointly in the Institute's *Journal* in 1914. This piece of work marked the beginning of the first period of Hanson's professional life, that devoted almost wholly to the research activities with which his name is likely to be remembered longest and on which his reputation may rest most securely. After a brief stay in the Research Department at Woolwich he became, late in 1913, a junior assistant in the Metallurgy Division of the National Physical Laboratory. He stayed at Teddington until 1926, by which time he had attained the grade of Senior Scientific Officer and had come to be generally regarded as Dr. Rosenhain's leading collaborator.

Hanson's period at the N.P.L. was exceedingly fruitful. His greatest interest lay in the determination of the constitution of alloys and the relations between constitution and properties. He excelled in devising and developing experimental methods; one of his earliest papers, written jointly with Dr. J. L. Haughton, recorded departures in connection with high-temperature thermostats. With Dr. Marie Gayler he published a long series of highly important papers that dealt with their researches into the constitution of aluminium alloys. These papers were completely authoritative and have decisively affected all subsequent thinking on this subject. More or less contemporaneously Hanson published another series of papers—in collaboration with Rosenhain and other members of the staff at the N.P.L.—on the effects of impurity elements upon the properties of copper; amazingly enough, during the same period, he also contributed papers to the *Journal* of the Iron and Steel Institute on the constitutions of some alloys of iron. In these same years he took no small part in the investigations into service failures that had been referred to the N.P.L., while he found time and energy to collaborate with Dr. H. J. Gough in some beautiful researches on the fatigue of metals. The metallographical work that was Hanson's particular contribution was unforgettably brilliant.

During the years spent at Teddington—the high summer of his scientific activity—Hanson played a great part in establishing the reputation for meticulous accuracy enjoyed by the Metallurgy Division. He had himself a passion for accuracy; he also had an unusual endowment of experimental resourcefulness which enabled him to cope with the most difficult metallographical problems. As a leading member of Rosenhain's team he was the perfect foil to his chief, whose romantic, imaginative boldness was well served by Hanson's clear, analytical outlook. The combination was formidable and produced some brilliant results.

When Hanson succeeded Professor Turner in the Feeney Chair at Birmingham, his second professional period began. Full of enthusiasm, he strove to build up a department which then lacked both an adequate quota of students and research

facilities. For a time greater numbers of students came to him, but the trade slump of 1929 made it difficult for students of metallurgy to find posts after graduation, and the number of entrants fell again. The creation of a research school that Hanson could consider worthy was even more difficult. Money was scarce, equipment hard to come by, the dead hand of the slump lay heavy on enterprise in education and research. Small wonder then that—striving with these difficulties—Hanson's research output diminished considerably. The thirty-three major papers of his N.P.L. period were matched by only a dozen or so in the corresponding period at the University of Birmingham. But the quality did not fall, and the later publications were as important and valuable as their predecessors. Mainly they dealt with the creep of metals, with gas porosity in aluminium alloys, and with cast iron.

Inevitably a departmental professor in a university cannot—and should not—devote his whole time to research. Students must be taught; administrative duties must be performed; the latter grow rather than diminish, and both activities detract from the time that a professor can devote to research. Almost always Hanson had worked in collaboration; in the long list of papers published by the Institute that bear his name, only two were written solely by him; and collaborators were rarely available during the years 1926 to 1936. Post-graduate students working for a Ph.D. degree were hardly of the calibre to make suitable partners for Hanson. Fortunately, in the late nineteen thirties, it became possible for him to build up more attractive research teams through the financial aid given by some industries and research organizations.

There can be little doubt that Hanson came to feel both frustration and disappointment during these years and that those feelings seriously affected his outlook. His great interest—active personal participation in experimental work—could no longer be pursued as he would have wished. No large number of students came to his department and, though Hanson was an excellent lecturer and teacher, the care and instruction of undergraduates did not deeply appeal to him or long stir him to enthusiasm. Unless, and until, a student showed himself to be potentially a valuable research man, he did not interest Hanson seriously. To use his own words, the average student, and the routine affairs of the department, bored Hanson to tears. He was deeply interested in the theory of education and in methods of teaching, but he experienced no overwhelming urge to participate in the practice.

To offset this boredom, Hanson took an increasing interest in the internal politics of the University. He also undertook a good deal of extra-mural work, notably as an expert witness in patent cases. His keenly analytical mind and his gift of clear exposition served him well in the courts; he enjoyed—as far as anyone can—the tussles with counsel that such work entails. The part he played in University affairs afforded him a good deal of satisfaction, though the diffidence he had acquired about being drawn into any activity became more marked and he sought as far as he could to limit his active participation in these matters. But he served the appointed period as Dean of the Faculty of Science with distinction and acquitted himself most successfully. That same clarity of outlook and keen appreciation of what is possible, combined with a measure of idealism, which marked his research work were brought to bear on administrative problems and bore valuable fruit. Gradually he became an elder statesman, albeit tinged with a little of Peter Pan, exercising a quiet but powerful influence in University matters and being consulted by metallurgical scientists all over the world. He almost ceased to take any active part in affairs outside the University, and it seemed as though the autumn of his life had come, all too soon.

Though distressing in most ways, the war brought some compensations. Towards its close the number of students of metallurgy increased markedly, helped by the grants made available by the Government. These, and the later grants to ex-service men, produced a growth in the number of applicants that was almost embarrassing. For the first time Hanson was in a position actually to decline men—and women—wishing to enter his department. About this time he entirely reorganized the scheme of teaching; really he revolutionized its basis and, at the same time, made the course a four-year one from matriculation. At the end of the war the expansion of university departments was being urged on all sides; clearly it was urgently needed in metallurgy at Birmingham; and the funds to make it possible had to be found. Some came from the Government, but the British Non-Ferrous Metals Federation provided more and enabled tremendous changes to be made. Though the Federation's support was primarily given to the creation of the new department of Industrial Metallurgy, and the provision of a professor in that subject, the funds they provided allowed also of a large extension of the old department and the creation of the school of Theoretical Metallurgy which became Hanson's most personal concern.

These striking events ushered in the third period of Hanson's active scientific life, and he enjoyed what Cardinal Newman had called a second spring. The presence of a professor of Industrial Metallurgy gave him a colleague with whom he was completely at ease, and banished that loneliness from which he had often suffered. Younger men, Dr. Raynor and Dr. Cottrell in particular, led departmental teams doing research of the highest quality and value; the Government provided the means for a large extension of the kind of research work that Hanson could happily supervise. Adequate equipment

became available and the reputation of the metallurgical work done at the University of Birmingham soared. Coincidentally Hanson discovered a new interest in the metallurgy associated with the atomic-energy projects at Harwell and elsewhere in this country. He relaxed the rigour of his seclusion and took part in the work of the advisory committees connected with these projects and also in the theoretical aspects of the work of the Inter-Service Metallurgical Research Council. He seemed to grow younger and though, as is natural, he never reverted to personal activity in research, he was a sage counsellor of those engaged in it. To the administrative affairs of the University he applied his considerable wisdom, reinforced by an almost unique experience of its internal politics. Though shrinking from much direct activity, he was always ready and willing to help and advise those who sought his aid.

To metallurgists all over the world Hanson's name is familiar. They can value the large bulk of work enshrined in his published papers—more than sixty of them—and can appreciate the influence he has exercised on metallurgical science. But those who knew Hanson personally, and certainly those who knew him at all well, will remember the man even more than his work. To them, men and women alike, he was always Dan, and there was no other Dan in his generation. He was a cheerful companion and loyal comrade, ever the same to those who enjoyed his friendship. Outside this small company of intimates many others knew him and valued their acquaintance with him. Those who had been his colleagues at the N.P.L. still talk of his stimulating and personal interest in their work and the help he gave unstintingly. But they talk at least as much of his dashing performances at football and of his virile, jovial manner at the daily tea parties, presided over by Rosenhain, when everything—from telescopes to telepathy—was discussed.

Hanson was always fond of outdoor things and loved the little farm he lived in. Characteristically his main interests there were in growing vegetables and in tending a rock garden by the scientific method. Most of his long holidays were spent in a caravan, usually near to either a trout stream or mountains. For many years he had been a skilful angler; for a time he indulged in rock climbing and was always interested in that adventurous recreation. During the last few years he had done a good deal of bird-watching but, much more enthusiastically, he began to paint, first in water colour and then in oil. Invariably he painted out-of-door subjects, on the spot, which was quite in keeping with his affections; and his meticulously accurate treatments naturally reflected the supremely competent experimentalist.

In 1920 Professor Hanson married Miss Hilda E. Fry. She also was a member of the Metallurgy Division at the N.P.L. and had collaborated with her future husband in a research on the constitution of the nickel–iron alloys, the results of which were published in the *Journal* of the Iron and Steel Institute in that same year. Never was a marriage more fitting, or happier; and their children have been an abiding joy to them. With Mrs. Hanson two daughters survive their father, but a tragic accident while climbing in the Alps killed his only son in 1949, abruptly ending a career that gave promise of academic brilliance.

LESLIE AITCHISON

LETTERS TO THE EDITOR

High-Strength β-Brass

I should like to comment on one or two points in the interesting letter by Dr. Lunn on the development of the high-tensile non-magnetic brass ("Galathea bronze") used for the containing spheres of deep-sea magnetometers.[1] First, the β alloy chosen is not completely unorthodox. Its composition involves merely replacement of iron by about one-third its weight of chromium in British Standard No. 1400-HTB3-C-1948, 48-ton high-tensile β-brass, and it has tensile characteristics similar to those of alloys made to this specification.

I can endorse the view that chromium acts as a grain-refining agent in Galathea bronze, because sand-cast alloys made to the above British Standard have a similar grain-size to that of Galathea bronze, whereas without iron such β alloys may have a grain-size about ten times larger.[2, 3] However, I cannot agree that iron is very effective in raising the yield (or tensile) strength in this kind of brass; there is no doubt that the main strengthening is derived from the presence of the aluminium.[2, 3, 4] The effect of iron seems to be associated with that of manganese in stabilizing the β phase,[5] and in improving ductility. It should be noted in this connection that in the ternary aluminium brasses at equilibrium, β cannot contain more than, at the most, about 4·4% aluminium. Greater amounts of aluminium lead to the presence of the γ phase in the structure.[6]

Dr. Lunn mentions the high susceptibility of Galathea bronze to stress-corrosion deterioration. It would be of value if he could supply any data which might be used to assess the effect of chromium in this respect. It has been demonstrated most clearly that high-tensile β-brasses containing appreciable amounts of aluminium are very prone to intercrystalline failure when under tensile stress in sea-water.[2, 3, 7] Further, it has been shown that this is most likely due to some intrinsic mechanical weakness.[2, 3] Moreover, in certain instances β alloys may display pronounced intercrystalline brittleness.[8, 9] A method claimed to overcome intercrystalline weakness in ternary β-brasses containing 2–5% aluminium has been patented recently.[10] It involves the addition of 0·01–0·5% titanium and/or zirconium.

A. R. BAILEY

Constantine Technical College, Middlesbrough.

REFERENCES

1. B. Lunn, *Bull. Inst. Metals*, 1953, **1**, (22), 209.
2. M. E. Whitaker, E. Voce, and A. R. Bailey, *Metallurgia*, 1948, **39**, 21, 66.
3. A. R. Bailey, *Metal Ind.*, 1952, **80**, 59.
4. H. J. Miller, *Metal Ind. (Lond.)*, 1936, **49**, 201, 229.
5. M. G. Corson, *Metal Ind. (New York)*, 1935, **33**, 86, 120, 160, 280.
6. O. Bauer and M. Hansen, *Z. Metallkunde*, 1932, **24**, 1, 73, 104.
7. T. L. Sheehan and H. E. Dickerman, *J. Amer. Soc. Naval Eng.*, 1946, **58**, 586.
8. C. H. Desch, "The Chemistry of Solids", p. 67. **1934**: Oxford (University Press).
   Symposium on "The Refining of Non-Ferrous Metals" (Inst. Min. Met.), **1950**, p. 15.
9. A. R. Bailey, *et al.*, work to be published shortly.
10. British Patent No. **683,122**.

Intercrystalline Cracking of Metals

Your correspondent on this subject[1] raises the interesting case in which a "stiff" metal failed by intercrystalline cracking under stress, and wonders whether it can be related to the migration of vacant lattice sites.

Although he does not actually say so, this query seems to imply a suggestion that the vacant-site hypothesis offers a unique solution of the cause of intercrystalline cracking. In the present writer's opinion this is not so. There may be many causes, according to the particular conditions.

Just Published

PROPERTIES OF METALLIC SURFACES

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Monograph and Report Series No. 13

8vo. Pp. 370, with 155 illustrations in the text. **Price £1.15.0 or $5.50, post free** (Each member of the Institute of Metals may buy one copy at **17s. 6d. or $3.00, post free**)

The volume contains 13 papers presented at a Symposium organized by the Metal Physics Committee of the Institute of Metals and held in London on 19 November, 1952.

The Symposium was designed to interest not only metallurgists but also engineers, physicists, and chemists, and a wide range of properties of metallic surfaces was covered, as may be seen from the list of titles given below. Some of the papers invited take the form of first-class reviews; others contain the results of important new researches. All are by authors outstanding in their respective fields.

The meeting attracted an attendance of nearly 500 people, a number of them from abroad. A valuable discussion took place and is reported *in extenso*, with illustrations, in the monograph. The whole book will prove invaluable to those whose work is concerned with any aspect of metal surfaces.

CONTENTS

Specialized Microscopical Techniques in Metallurgy. By Professor S. Tolansky. **Radioisotopes in the Study of Metal Surface Reactions in Solutions.** By Massoud T. Simnad. **The Influence of Machining and Grinding Methods on the Mechanical and Physical Condition of Metal Surfaces.** By Peter Spear, Ian R. Robinson, and K. J. B. Wolfe. **The Effect of Lubrication and Nature of Superficial Layer After Prolonged Periods of Running.** By F. T. Barwell. **The Crystalline Character of Abraded Surfaces.** By P. Gay and P. B. Hirsch. **The Effect of Surface Conditions on the Mechanical Properties of Metals, Mainly Single Crystals.** By Professor E. N. da C. Andrade. **The Effect of Surface Condition on the Strength of Brittle Materials.** By Professor C. Gurney. **The Influence of Surface Condition on the Fatigue Strength of Steel.** By R. J. Love. **The Influence of Surface Films on the Friction and Deformation of Surfaces.** By F. P. Bowden and D. Tabor. **Diffusion Coatings.** By D. M. Dovey, I. Jenkins, and K. C. Randle. **The Nature and Properties of the Anodic Film on Aluminium and Its Alloys.** By H. W. L. Phillips. **Chemical Behaviour as Influenced by Surface Condition.** By U. R. Evans. **The Effect of Method of Preparation on the High-Frequency Surface Resistance of Metals.** By R. G. Chambers and A. B. Pippard.

THE INSTITUTE OF METALS
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In the case mentioned by Mr. Bailey, it would appear that the precipitation of a brittle film of γ phase would be sufficient under the circumstances to determine the intercrystalline path of the crack. The γ phase has a higher specific volume than the β phase, and hence its separation in the boundaries would increase the stress due to the external stress and also cause stress concentration. The relatively short time needed to cause failure at ordinary temperature would seem to preclude any important contribution by migration of vacant sites. By extrapolation of a linear semi-logarithmic plot in the case of α-brass, it is indicated that several years under a stress equivalent to the ultimate would be needed to cause failure by intergranular cavitation even at 60° C.

J. Neill Greenwood

The Baillieu Laboratory,
Melbourne University.

REFERENCE

1. A. R. Bailey, *Bull. Inst. Metals*, 1953, **1**, (20), 187.

"Whisker" Growths on Copper

Your correspondent Dr. Wakelin, in recording a development of filamentary growths on copper, has remarked on the inadequacy of the various theories which have so far been advanced to explain such occurrences. I would like to record some experimental observations which appear to be relevant, although admittedly they can only intensify the difficulty of establishing a general cause of these phenomena.

Most of the filamentary growths recorded in the literature have, like those noticed by Dr. Wakelin, occurred on heated metals. Not only is this true of the copper filaments described in the references quoted by Dr. Wakelin, but it applies also to the hair-like silver fibres which have been described by Kohlschütter [2] and others. Explanations advanced in such cases have generally been concerned with the mechanism of thermal reduction of oxide or sulphide surface layers. It may be difficult to extend such theories to explain the "whiskers" developed at normal storage temperatures on plated surfaces of cadmium, zinc, and tin, as described by Compton, Mendizza, and Arnold,[3] while an entirely different cause must presumably operate to give the filaments and dendrites of silver which have been reported by Berry.[4] It seems, therefore, particularly difficult to explain by any existing theory some very luxuriant copper filaments which have recently been observed here to grow as attachments to the faces of copper cathodes while the latter are receiving a copper electrodeposit.

Specimens of such growths are shown in Fig. 1. These specimens are by no means isolated examples; indeed they have become of fairly common occurrence when certain operative conditions are maintained. Of these conditions, very low current density at the cathode and complete absence of motion of cathode or electrolyte are certainly essential. (Some other factors incidental to the experiments may, of course, have important influences.)

When found, these filaments tend to be of approximately cylindrical form, although their superficial contour and the fact that their thickness varies are matters which are not necessarily of significance, since, after their initial formation, they participate as portions of the cathode in all subsequent deposition, and so they steadily increase in girth. Cases have been observed, however, where in the early stages of growth they have been very long and extremely tenuous in form. Micrographic examination of such filaments has shown no evidence of single-crystal structure.

Some clue to the mechanism causing these particular growths may be afforded by the observation that they are more readily produced when specific batches of plating solution are used, and these batches have been proved to

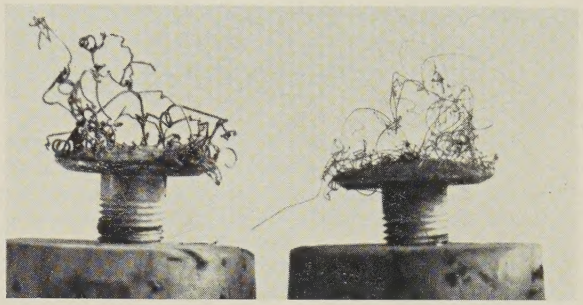

Fig. 1.—Filamentary Growths Developed on Copper Cathode Discs During Electrodeposition of a Copper Coat.

contain traces of a known colloidal contaminant. It has, moreover, been observed that when these growths are developing, an abnormal potential drop is usually apparent in the region of the cathode face. This matter is being further examined.

I should be very interested to know whether any filaments of this remarkable form have been encountered by other workers in electrodeposition and, if so, whether any theory has successfully explained their occurrence.

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REFERENCES

1. R. J. Wakelin, *Bull. Inst. Metals*, 1953, **1**, (20), 186.
2. H. W. Kohlschütter, *Z. Elektrochem.*, 1932, **38**, 345.
3. K. G. Compton, A. Mendizza, and S. M. Arnold, *Corrosion*, 1951, **7**, 327.
4. C. R. Berry, *J. Opt. Soc. Amer.*, 1950, **40**, 615.

NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

Birmingham Metallurgical Society

The Society's Jubilee will be celebrated on Wednesday, 21 October 1953, at the Grand Hotel, Birmingham, when four papers will be given.

The programme will be as follows:

10.0 to 11.0	"Fifty Years of Progress in the Non-Ferrous Industries", by Dr. Maurice Cook.
11.0 to 11.30	Coffee and biscuits.
11.30 to 12.30	"Fifty Years of Progress in the Ferrous Industries", by Dr. J. W. Jenkin.
12.30 to 1.0	Cocktails.
1.0 to 3.0	Lunch, at which the Lord Mayor is expected to be present.
3.0 to 4.0	"Fifty Years of Progress in Metallurgical Education", by Dr. T. Wright.
4.0 to 4.30	Tea.
4.30 to 5.30	"Fifty Years of Progress in Our Understanding of Metals", by Dr. N. P. Allen.

THERMODYNAMICS OF ALLOYS

By JOHN LUMSDEN, B.Sc.
(Research Department, Imperial Smelting Corporation, Ltd.)

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Lubricants for the Cold Working of Non-Ferrous Metals, by S. F. Chisholm (Vacuum Oil Co., Ltd.).

The Cold Rolling of Non-Ferrous Metals in Sheet and Strip Form, by C. E. Davies (W. H. A. Robertson and Co., Ltd.).

Wire-Drawing Technique and Equipment, by F. T. Cleaver and H. J. Miller (British Insulated Callender's Cables Ltd.).

The Deep Drawing and Pressing of Non-Ferrous Metals and Alloys, by J. Dudley Jevons (Joseph Lucas, Ltd.).

General Discussion on Metallurgical Aspects of the Cold Working of Non-Ferrous Metals and Alloys.

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EQUIPMENT FOR THE

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NEWS OF KINDRED SOCIETIES

Associazione Italiana di Metallurgia

Conference on Corrosion

The Electrochemical Section of the Associazione Italiana di Metallurgia is sponsoring a national conference on corrosion in Milan on 8, 9, and 10 October next.

The National Research Council of Italy is granting its patronage to the Congress and will give financial support to the publication of its Proceedings in a special number of *La Metallurgia Italiana.*

The following themes will be covered:

1. The phenomena of passivity in metals and alloys.
2. The oxidation of metals and alloys at high temperatures.
3. Protection against corrosion by means of inhibitors.
4. Corrosion and protection of metals and alloys underground.
5. Phenomena of corrosion and passivity in plant and equipment in the chemical industry.
6. Methods of testing and control in metallic corrosion and protection.
7. Information and research methods in the service of corrosion prevention.

The names of the speakers will be announced as soon as possible. A lecture by Professor Marcel Pourbaix of Brussels, on the organization of Centre Belge d'Etude de la Corrosion (Cebelcor), has already been arranged.

In addition, it is planned to have brief communications on the subjects listed above, as well as a general discussion on all the papers.

Symposium on Electrolysis of Aluminium

On 12–14 October the Electrochemical Section is also holding in Milan a Symposium on the Electrolysis of Aluminium, at which papers will be presented by French, German, and Italian scientists.

Details of both the conference and the symposium may be obtained from the Associazione Italiana di Metallurgia, Via Moscova 16, Milan.

Australian Institute of Metals

The sixth annual meeting of the Australian Institute of Metals was held during the last week of May in Brisbane. The Brisbane Branch is the youngest of the six branches of the Institute. Sixty-five interstate delegates joined a similar number of Brisbane members in a full programme of technical discussions, works visits, and social activities.

Federal office-bearers for 1953–54 are:

President: Mr. Clement Blazey (Port Kembla).
Vice-Presidents: Mr. L. W. Malmgren (Sydney) and Professor H. K. Worner (Melbourne).
Honorary Secretary: Mr. E. G. Love (Melbourne).
Honorary Treasurer: Mr. E. D. Connor (Melbourne).

The retiring Federal President, Professor F. T. M. White (Brisbane) chose the title "Man, the Metallurgist" for his Presidential Address and traced the history of the discovery and use of metals from prehistoric times to the present day. The 1953 Invitation Lecturer was Dr. F. A. Fox, recently appointed Assistant Controller of Research, Commonwealth Department of Supply, who spoke on "Recent Developments in Light Alloys". The two technical sessions were concerned with "Rare Metals, Their Production and Utilization", and "Copper and Copper-Base Alloys", respectively.

Société Française de Métallurgie

The Autumn Meeting of the Société Française de Métallurgie will be held at the Maison de la Chimie, Paris, from 19 to 23 October. A detailed programme of the proceedings will be distributed in September. Further information may be obtained from the Secretary of the Société, 25 rue de Clichy, Paris (IXe).

OTHER NEWS

Conference on Hardness Testing

The Sheet and Strip Metal Users' Technical Association is holding a special conference on "Hardness Testing" at the City Hall, Sheffield, on 14–16 October 1953.

The programme of papers to be presented is as follows;

"Hardness Testing with the Vickers Machine", H. G. Harper (Vickers-Armstrongs, Ltd.).

"Rockwell Hardness Testing of Sheet Material", V. E. Lysaght (Wilson Mechanical Instrument Co.).

"Standard Indentation Tests", Dr. K. Meyer (Institut für Härterei Technik, Bremen-Lesum).

"Micro-Hardness Testing—both in Micro and Macro", E. B. Bergsman (AB Svenska Metallverken, Vasteras).

"The Reichert Micro-Hardness Tester in Practice", Dr. Onitsch (Shandon Scientific Company).

"Reproducibility of Hardness Tests", J. Woolman (Brown-Firth Research Laboratory).

"Scratch Hardness Testing", D. A. Oliver (B.S.A. Group Research Centre).

"Practical Applications of the Double-Cone Indenter", P. Grodzinski (Industrial Distributors (Sales), Ltd.).

"Value of Hardness Testing as Inspection Procedure", Dr. W. G. Shilling (A.I.D., Harefield).

"Physical Meaning of Indentation Hardness", Dr. D. Tabor (Cambridge University).

An interesting and important part of the Conference will be the exhibition of hardness-testing machines and equipment which will be staged by the manufacturers throughout the period. These exhibits will be of great technical interest, and members and others attending the Conference, or otherwise in Sheffield at that time, will be very welcome to visit the exhibition and discuss the merits of the different machines with the exhibitors.

Further details may be obtained from the Honorary Secretary of the Association, 49 Wellington Street, Strand, London, W.C.2

Third International Congress of Crystallography

The Third General Assembly of the International Union of Crystallography and International Crystallographic Congress is to be held in Paris on 21–28 July 1954. It is proposed to hold an exhibition of crystallographic apparatus and publications during the Congress. All correspondence concerning this exhibition should be directed to the Secretary of the Local Committee in Paris (Dr. J. Rose, Laboratoire de Minéralogie, 1 rue Victor Cousin, Paris Ve), from whom further particulars may be obtained.

International Congress of Light Metals

The Congress of Light Metals which the Montanistische Hochschule, Leoben, had intended to hold in the summer of 1954 has been postponed until 1955 on account of the International Aluminium Congress that is to take place in Paris in 1954 to mark the centenary of the commercial production of aluminium by Sainte-Claire Deville.

British Standards Institution

The British Standards Institution has moved to new premises at 2 Park Street, London, W.1 (MAYfair 9000).

Works Visits

Wild-Barfield Electric Furnaces, Ltd., are again extending an invitation to senior students of technical colleges and like institutions to visit their Works during the coming winter season, from October to May. The tours include an inspection of the Research and Development Departments, as well as of the production side, and take place during the afternoon of any work day (Monday to Friday). As these tours have now become a popular feature with senior technical students, readers would be well advised to apply for a date, giving alternatives, as soon as possible.

DIARY

The Institute

21 September. Twenty-fourth Annual Autumn Lecture: "The New Metal Titanium", by Dr. Maurice Cook. Non-members will be welcome; tickets of admission are not required. (Town Hall, Southport, at 6.30 p.m.)

22–25 September. Autumn Meeting at Southport. For full details, see August issue of the *Bulletin*, pp. 218–222.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following staff vacancies in the Metallurgical Research Laboratories of the British Welding Research Association.

(*a*) *Metallurgist* for investigations on the thermal aspects of welding heat-treatable aluminium alloys. Experience of welding is not essential, but a sound knowledge of aluminium alloys is desirable.

(*b*) *Metallurgist or Metallurgical Engineer* for investigations on the gas-shielded metal-arc welding of ferrous and non-ferrous alloys.

(*c*) *Laboratory Assistant* with experience of metallography, mechanical testing, and heat-treatment.

For positions (*a*) and (*b*), applicants should be under 30 years of age, with degree or professional qualification. Research experience an advantage. Salary range £500–800 per annum according to age and experience.

For position (*c*), the salary range is £300–400 per annum for applicants within the range 20–25 years of age.

Applications to: Secretary, 29 Park Crescent, London, W.1.

EDITORIAL ASSISTANT required. A metallurgical or mechanical background is desirable, but applicants with training in other branches of science or technology would be considered. Details of education, experience, and age to: The Editor, Journal of The Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W.1.

GRADUATE METALLURGISTS are required for research on tungsten, molybdenum, and other high-temperature materials. Research experience is an advantage but not essential. Apply giving age, qualifications, and experience and quote reference MT, to: The Director of Research, The British Thomson-Houston Co., Ltd., Rugby.

LIGHT ALLOY FOUNDRY. Applications are invited for a senior executive appointment in an important light alloy foundry. Applicants should be 35–45 years and at present in receipt of four-figure salary; must have wide experience in production of aluminium and magnesium castings by the most modern methods; proved administrative ability and preferably an engineering background. Box No. 352, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

MAGNESIUM ELEKTRON LIMITED invite applications for the position of Head of X-Ray Section of Metallurgical Research Laboratory. Applications should be qualified in Physics or Metallurgy or possess A.I.D. approval and should be anxious to specialize in radiography and X-ray diffraction. Applications in writing with details of qualifications and experience to Secretary, Magnesium Elektron, Ltd., Clifton Junction, Nr. Manchester.

METALLURGIST is required for central research department. The work consists of research on a variety of problems connected with hot and cold working and heat-treatment of steels. Applicants should have a good metallurgical degree and, preferably, research experience. Salary according to experience and qualifications. Apply in writing to Tube Investments, Ltd., Dept. of Development and Research, Plume Street, Aston, Birmingham 6.

METALLURGIST required for control and development of works processes, including casting, rolling, extruding, heat-treatment of aluminium and aluminium alloys. Applicants should not be over 30 years of age, and must possess degree. Please write giving full details career, and salary expected, to Personnel Manager, Northern Aluminium Company, Ltd., Banbury.

MULLARD BLACKBURN WORKS, LTD., require a Metallurgist to advise on tool hardening and to work on factory assistance concerning electronic valve manufacture. Candidates should either be Associates of the Institution of Metallurgists or possess equivalent qualifications. A good salary will be paid. Applications should be in writing and addressed to the Works Personnel Officer, Mullard Blackburn Works Ltd., Philips Road, Blackburn. Please quote ref. MTH/FA.

UNIVERSITY OF BIRMINGHAM

Feeney Chair of Metallurgy

Applications are invited for the above Chair at a salary not less than £2100 per annum, duties to commence in the early part of 1954.

Applications (6 copies) with names of three referees (no testimonials) should be sent to The Registrar, The University, Edgbaston, Birmingham, 15, by 30 September 1953.

Further particulars may be obtained from the undersigned.

C. G. BURTON,
Secretary.

The University,
Birmingham 3.
July, 1953.